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Proceedings of the PSARC Salmon Subcommittee Meeting

May 13-14, 2002
Best Western Dorchester Hotel
Nanaimo, BC

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Fisheries and Oceans Canada
Pacific Scientific Advice Review Committee
Pacific Biological Station
Nanaimo, British Columbia V9T 6N7

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PACIFIC SCIENTIFIC ADVICE REVIEW COMMITTEE (PSARC)
SALMON SUBCOMMITTEE MEETING

SUMMARY

The PSARC Salmon Subcommittee met May 13 and 14, 2002 at the Best Western Dorchester Hotel, Nanaimo, B.C. to review new information on biological escapement goals for upper Yukon fall chum salmon, defining stock groupings for Fraser River chinook, the development of habitat-based escapement goals for Fraser River chinook and the status of Sakinaw Lake sockeye.

Working Paper S2002-07: Biological escapement goals for Yukon River fall chum salmon

The objectives of this paper were to: 1) present a reconstruction of the total Yukon River fall chum salmon runs (stock-specific catch and escapement) for the years 1974 – 1999, by age, for stocks including those spawning in Canadian waters (Upper Yukon tributaries including the Fishing Branch River and the Upper Yukon mainstem); 2) document the current approach to stock-recruitment analysis used for these runs; and 3) recommend to Alaska Department of Fish and Game (ADF&G) biological escapement goals (BEG's) for five indicator populations. Data on spawner escapement estimate, catch and age composition were used to re-construct runs. These data were used to develop spawner-recruit relationships, and to estimate biological escapement goals.

The Subcommittee acknowledged that a substantial amount of work was required to assemble a considerable body of data and that the presented paper is a solid base on which to complete further analysis. However, the Subcommittee did not accept the paper because of concerns about some aspects of data quality. Escapement estimates were based on expansion factors that attempted to correct for incomplete time series. The Subcommittee judged the techniques used to derive the expansion factors to be deficient. In addition, stock compositions of catches were not adequately described. Finally, the effects of uncertainty in the data and derived parameter estimates were not adequately evaluated. The author's efforts were appreciated and he was encouraged to continue working to address data quality and analytical issues.

Working Paper S2002-08: A discussion paper on proposed stock groupings for Fraser River chinook

This paper presents an hierarchical approach used to identify population units for chinook salmon returning to the Fraser River watershed. Data used included results of genetic analysis of samples collected throughout the Fraser River drainage basin, coded-wire tag results documenting marine catch distributions, life history information including stock-specific migrations timing through the lower Fraser River, juvenile life history patterns, dates of peak spawning, and age at return. A hierarchical classification scheme used to develop Conservation Units was presented.

The Subcommittee accepted the paper with revisions. The focus of the revisions should be to define the technical basis for the levels of differentiation and not to develop a preferred set of Conservation Units. The Subcommittee recommends that the stock groupings not be accepted because the analytical framework is still in a formative stage.

Working Paper S2002-09: Habitat-based methods to develop escapement goals for chinook salmon in the Fraser River

The objective of this paper was to describe habitat-based methods for developing escapement goals for Fraser River chinook populations. Biophysical information was used to characterize spawning streams and partition them into strata. Biological information on migration, spawning time and juvenile rearing habitat use were used with the biophysical data to develop models to describe spawning fish-habitat relationships. Ultimately, estimates of numbers of spawners at the Maximum Sustained Yield (MSY) were calculated using general chinook stock productivity parameter estimates and the fish habitat models.

The Subcommittee accepted the Working Paper with revisions. It considered the approach presented as a developing methodology and did not accept the reference points. The Subcommittee recommended that the paper be re-presented after major revisions, which will be outlined by the Subcommittee in a memo.

Working Paper S2002-10: Status of Sakinaw Lake sockeye salmon (Oncorhynchus nerka)

This paper provided an update on the status of Sakinaw Lake sockeye salmon in statistical Area 16 and reviewed current understanding of reasons for their decline. A variety of data was presented pertaining to the status of the population and its habitats, its special characteristics, its exploitation history and reasons for its decline including human interventions (e.g. Cutthroat stocking, development impacts). Escapement estimates appeared somewhat stable from 1955 to 1985 with a peak of 16,000 sockeye in 1975. The population has decreased rapidly in the last 12 years and the 1996-2001 average is about 80 fish. The authors concluded that, if present conditions continue, Sakinaw Lake sockeye salmon are at a high risk of extirpation.

The Subcommittee accepted the Working Paper with revisions. It recommended that work on a recovery plan begin as soon as possible. This includes developing a comprehensive statement on stock status, identifying risk factors and designing measures to offset those risk factors. Experts can determine the priority of parts of the recovery plan. The specific recommendations of the Working Paper should be considered in the plan. Monitoring programs should continue through the recovery plan process. Accurate smolt and adult enumeration is a high priority.

SOMMAIRE

Le sous-comité du saumon du CEESP s'est réuni les 13 et 14 mai 2002 à l'hôtel Best Western Dorchester, à Nanaimo (Colombie-Britannique) pour passer en revue les nouveaux renseignements sur les objectifs biologiques d'échappées pour le saumon kéta d'automne du cours supérieur du fleuve Yukon, les objectifs d'échappées axés sur l'habitat établis pour le saumon quinnat du Fraser, les groupes de stocks proposés pour le saumon quinnat du Fraser et l'état de la population de saumon rouge du lac Sakinaw.

Document de travail S2002-07 : Objectifs biologiques d'échappées pour le saumon kéta d'automne du fleuve Yukon

Le présent document visait les objectifs suivants : 1) reconstituer les remontes totales de saumon kéta d'automne dans le fleuve Yukon (prises et échappées pour chaque stock) pendant la période 1974 – 1999, selon l'âge, pour tous les stocks, y compris ceux qui frayent dans les eaux canadiennes (affluents du cours supérieur du fleuve Yukon, y compris la rivière Fishing Branch et l'axe fluvial du cours supérieur du fleuve; 2) documenter l'approche actuelle à l'analyse stock-recrutement appliquée à ces remontes; et 3) recommander au ministère de la Pêche et de la Chasse de l' Alaska des objectifs biologiques d'échappées pour cinq populations indicatrices. La reconstitution des remontes repose sur des données sur les estimations des échappées, les prises et la composition par âge. Ces données ont aussi servi à établir des relations entre le nombre de reproducteurs et le nombre de recrues et des objectifs biologiques d'échappées.

Le sous-comité est conscient du grand effort requis pour rassembler cette masse de données et considère que le document présenté constitue une assise solide pour faire de nouvelles analyses. Malgré cela, il n'a pas accepté le document en raison des préoccupations que soulève la qualité des données. Par exemple, les estimations des échappées reposent sur des facteurs d'extension visant à tenir compte de l'insuffisance des séries chronologiques. Mais, selon le sous-comité, les méthodes utilisées pour calculer ceux-ci étaient imparfaites. Il est aussi d'avis que la représentation des stocks dans les prises n'est pas suffisamment décrite. En dernier lieu, les effets de l'incertitude des données et des estimations des paramètres dérivées ne sont pas évalués adéquatement. Les efforts de l'auteur sont appréciés et le sous-comité l'encourage à régler les problèmes de qualité des données et des analyses.

Document de travail S2002-08 : Groupes de stocks proposés pour le saumon quinnat du Fraser

Est présentée une approche hiérarchique à l'identification des unités de population du saumon quinnat retournant au bassin versant du Fraser, fondée sur les résultats d'analyses génétiques d'échantillons recueillis à l'échelle du bassin, des données de micromarques magnétisées codées documentant la distribution des prises en mer,

de l'information sur les cycles vitaux, y compris le moment de la migration de chaque stock dans le cours inférieur du Fraser, l'histoire naturelle des juvéniles, les dates de la période de pointe de la fraie et l'âge à la remonte. Est aussi présenté un plan de classification hiérarchique pour délimiter les unités de conservation.

Le sous-comité a accepté le document sous réserve de révisions. Le but des révisions devrait être de définir la base technique pour les niveaux de différentiation et non pas de développer une série préférée d'unités de population. Le sous-comité recommande que le regroupement des stocks ne soit pas accepté car le cadre analytique est encore en voie d'élaboration.

Document de travail S2002-09 : Méthodes d'établissement d'objectifs d'échappées axés sur l'habitat pour le saumon quinnat du Fraser

Sont décrites dans le présent document des méthodes d'établissement d'objectifs d'échappées axés sur l'habitat pour les populations de saumon quinnat du Fraser. L'auteur a utilisé des renseignements biophysiques pour caractériser les cours d'eau de fraie et les diviser en strates, puis les a ajoutés à des données biologiques sur la migration, l'époque de la fraie et l'utilisation de l'habitat d'alevinage par les juvéniles pour élaborer des modèles pour décrire les relations entre les reproducteurs et l'habitat. En dernier lieu, il a fait des estimations du nombre de reproducteurs au rendement maximal soutenu (RMS) reposant sur des estimations générales des paramètres de productivité des stocks de saumon quinnat et les modèles de l'habitat du poisson.

Le sous-comité a accepté le document sous réserve de révisions. Il considère que l'approche a été présenté comme une méthodologie en développement et ne doit pas être acceptée comme un point de référence. Le sous-comité a recommandé que le document soit présenté à nouveau après des révisions de fond, qu'il expliquera dans une note de service.

Document de travail S2002-10 : État de la population de saumon rouge (*Oncorhynchus nerka*) du lac Sakinaw

Les auteurs font une mise à jour de l'état de la population de saumon rouge du lac Sakinaw, situé dans la zone statistique 16, et passent en revue l'état des connaissances expliquant leur déclin. Ils présentent une gamme de données sur l'état de la population et ses habitats, ses caractéristiques particulières, l'historique de son exploitation et les raisons à l'origine de son déclin, y compris les interventions de l'homme (p. ex., stockage de truites fardées, répercussions du développement). Les auteurs concluent que, si les conditions actuelles perdurent, la population de saumon rouge du lac Sakinaw risque fort d'être déracinée.

Le sous-comité a accepté le document de travail sous réserve de révisions. Il a recommandé qu'un plan de rétablissement soit préparé dans les plus brefs délais, y compris un exposé complet sur l'état du stock, les facteurs de risque et des mesures de compensation de ceux-ci. Des spécialistes établiront la priorité des parties du

plan de rétablissement. Ce dernier devrait aussi tenir compte des recommandations formulées dans le document de travail. Les programmes de surveillance en place devraient se poursuivre et le dénombrement précis des smolts et des adultes est une priorité élevée.

INTRODUCTION

The PSARC Salmon Subcommittee met May 13 and 14, 2002, at the Best Western Dorchester Hotel in Nanaimo, British Columbia. External participants from the Pacific Fisheries Resource Conservation Council, Sierra Club, Sports Fishing Advisory Board, Fishing Vessel Owners Association and Yale First Nations attended the meeting. The Subcommittee Chair, R. Tanasichuk, opened the meeting by welcoming the participants. During the introductory remarks, the objectives of the meeting were reviewed, and the Subcommittee accepted the meeting agenda.

The Subcommittee reviewed four Working Papers. Summaries of the Working Papers are in Appendix 1. The meeting agenda appears as Appendix 2. A list of meeting participants, observers and reviewers is included as Appendix 3.

DETAILED COMMENTS FROM THE REVIEW

S2002-07: Biological escapement goals for Yukon River fall chum salmon

D. Eggers **Not Accepted**

Rapporteur: Arlene Tompkins

The objectives of this paper were to: 1) present a reconstruction of the total Yukon River fall chum salmon runs (catch and escapement) for the years 1974 – 1999, by age, for stocks including those spawning in Canadian waters (Upper Yukon tributaries including the Fishing Branch River and the Upper Yukon mainstem); 2) document the current approach to stock-recruitment analysis; and 3) recommend biological escapement goals (BEG's) for five indicator populations.

Data

Data on spawner escapement estimate, catch and age composition were used to re-construct runs and to develop spawner-recruit relationships.

Both reviewers and the Subcommittee expressed numerous concerns about data quality and the unexplored effects that it would have on the author's conclusions. The concerns about data quality included high measurement errors in the escapement estimates, the paucity of stock composition estimates in fisheries, weak assumptions about the stock structure of the resource, and potential biases in the sampling

methods used to derive age information. Reviewer 2 quoted a recent study of the enumeration methods for the Fishing Branch River which showed poor correspondence between aerial and weir counts. Reviewer 2 was critical of the author assuming that all stock components have similar run timing through mixed-stock fisheries, similar exploitation rates, and that the catch for a particular stock is proportional to escapement abundance. This reviewer also stressed that, based on genetic differences, chum spawning in the Yukon River drainage upstream of the border are not a single stock and therefore should not be managed and assessed as one.

Methods

Spawner-recruit relationships were developed by fitting paired observations of recruits and escapement to a Ricker recruitment curve. Estimated spawning size that produces maximum sustained yield or MSY (S_{MSY}) and 90% confidence intervals were calculated through bootstrapping of residuals from the regression.

Reviewer 1 was concerned with the effects of error in run reconstruction on S-R parameter estimates. He recommended that revisions include simulations to show the amount of potential parameter bias over the plausible range of measurement errors.

The Subcommittee had concerns regarding the effect of error and ignoring large-scale environmental effects on the estimate of S_{MSY}. It recommended a sensitivity analysis be considered in future analyses. The analysis could address the effects of error in various inputs such as expansion factors, catch, run-timing assumptions and the estimated age composition. The Subcommittee was concerned that stock-based differences in productivity were not adequately addressed. Various stock structure scenarios should have been examined through sensitivity analysis.

Subcommittee Conclusions

The Subcommittee concluded, as did the Reviewers, that there are major data deficiencies and that data analyses are incomplete because the effect of error has not been examined in detail through sensitivity analysis. It did not accept the paper because of concerns about some aspects of data quality. Escapement estimates were based on expansion factors that attempted to correct for incomplete time series. The Subcommittee judged the techniques used to derive the expansion factors as deficient. In addition, stock compositions of catches were not adequately described. Finally, the effects of uncertainty in the data and derived parameter estimates were not adequately evaluated. The effort expended by the author was appreciated and he is encouraged to continue working to address the data quality and analytical problems.

Subcommittee Recommendations

The proposed BEG's have an inadequate technical basis and should not be accepted.

S2002-08: A discussion paper on proposed stock groupings for Fraser River chinook

J.R. Candy, J.R. Irvine, C. K. Parken, S.L. Lemke, R.E. Bailey, M.Wetklo and K. Jonsen **Accepted with revisions**

Rapporteur: Mike Folkes

The purpose of this paper was to present a hierarchical method to define stock structure for chinook salmon returning to the Fraser River watershed. The structure would be defined using genetic information and other biological parameters useful in describing the vulnerability of these stocks to fisheries or other uses. The paper was the first attempt to define conservation units for chinook salmon in BC.

Data

Data were for the 61 chinook populations from which genetic samples were collected. Additional information included life history information (juvenile life history, timing of return and spawning, age at return), results of queries of the Mark Recovery Programme database providing information on marine catch distributions, and results from genetic analysis of test fishery catches in the lower Fraser River.

Methods

A hierarchical classification scheme was used to develop provisional Conservation Units (CU). A CU was defined as one or more populations that share a common genetic lineage and can be managed effectively as a unit by virtue of their common productivity and vulnerability to fisheries. The first CU tier was the Evolutionary Significant Unit (ESU). The second and subsequent tiers pertain to productivity (recruits per spawner) and manageability (susceptibility to capture in marine and freshwater fisheries) respectively. Productivity has only been estimated for one spawning system (Harrison River) in the Fraser River watershed and therefore the presence or lack of large lakes was used to indicate relative levels of productivity.

Reviewer 1 suggested using a different hierarchy (1st Genetic, 2nd Marine Distribution, 3rd Run Timing, and 4th Productivity) to be more consistent with the technical value of the data available and possibly more logical in terms of management considerations. In addition, the basis of the ESU definition seemed justified but bases of CU definition below that level are not well substantiated, partially because of data limitations and partially because material on productivity,

marine distributions, run timing, and terminal fishery units is not well described or analyzed. Reviewer 2 thought that the paper should exhaustively review the available information on the populations in question and place the data in context of what is observed across the range of the entire species. Both reviewers and the Subcommittee were critical of the use of productivity as defined by the authors.

Both reviewers felt that paper would benefit from a more critical description of the genetic models used, their implicit assumptions, and the statistical consequences of these assumptions.

Results

The classification presented was not accepted because the Subcommittee felt that the procedure is in a formative stage. The Subcommittee felt that this Working Paper should be viewed as a discussion paper that considers different hierarchies, as suggested by Reviewer 1. The use of different hierarchies would clearly emphasize the role of the paper as a discussion paper and that one set of conservation units has not yet been endorsed by PSARC.

Both Reviewers were complimentary. Reviewer 1 felt that the authors are to be commended on this first effort to define CUs for chinook salmon, but a more balanced analysis of genetic and non-genetic information needs to be developed. Reviewer 2 thought that the paper takes some initiative towards trying to delimit Evolutionary Significant Units and Conservation Units for Fraser River chinook and in doing so provides a useful starting point for launching discussion on what criteria should be used to determine ESUs and CUs for Canadian salmon stocks.

Subcommittee Conclusions

The focus of this paper should be to define the technical basis for the levels of differentiation and not to develop a preferred set of CUs. The Subcommittee accepted an authors' suggestion that the purpose of the paper was to initiate discussion within the region so that, ultimately, a hierarchical approach can be developed which will reflect Departmental objectives. Determining the number and size of CUs for Fraser chinook will require the articulation of management objectives and a consideration of the costs and benefits of various scenarios. This requires discussion between fisheries management and stock assessment staff.

Subcommittee Recommendations

The Subcommittee accepted the Working Paper with revisions. The Subcommittee recommends that the stock groupings not be accepted because the analytical framework is still in a formative stage.

S2002-09: Habitat-based methods to develop escapement goals for chinook salmon in the Fraser River

C. K. Parken, J. R. Irvine, R. E. Bailey, and I. V. Williams
Accepted with Revisions

Rapporteur: Rick McNicol

The objective of this paper was to describe habitat-based methods for developing escapement goals for Fraser River chinook populations.

Data

Various types of data were used to develop the models. These included physical characteristics, such as the peak flow index, watershed area, and gradient. Biological data included peak spawning period, age-at-maturity, juvenile rearing habitat use, migration timing and escapement estimates.

Reviewer 2 felt that the dataset presented is not well-suited to the purposes of the paper. It was assumed to be the best available dataset and is typical of the data that will be produced by routine stock assessment methods. The Reviewer felt that, within the constraints of the data, the analyses are (generally) appropriate and support the conclusions.

Methods

Analyses consisted of: 1) developing predictive relationships for number of spawners considering, and then alternatively ignoring, habitat quality (as indicated by stream gradient); and 2) estimating limit reference points.

The Subcommittee and Reviewers were concerned about a number of issues about model development. These included assumptions about whether maximum spawner abundance is the appropriate metric for determining habitat capability, the relationship between the scale of habitat attribute variability and size of the stratum, scaling factors and expanding stratum-specific estimates to the system level. Reviewer 1 suggested that simpler models of capacity could have been examined; the authors collected data on hydrological characteristics and other attributes that could be used to help describe spawner densities but were not. The Subcommittee felt that a factor related to gradient may be important for chinook and suggested that the authors give this considerably more thought.

The spawner abundance producing MSY was estimated by bootstrap analyses for each model. The stock productivity estimates (i.e. *a*) used were for populations in Alaska, British Columbia, and the Columbia River. Both Reviewers were skeptical of estimating S_{MSY}. Reviewer 2 suggested that the technical issues that need to be addressed before the empirical gradient-spawner abundance relation can be usefully

applied to the estimation of S_{MSY} are: (1) model validation; (2) spatial scale; and (3) what stock-recruitment parameter does habitat capability actually measure. The authors equated their habitat capability estimate to the "b" parameter of the Ricker stock-recruitment relationship, i.e., to the equilibrium spawner abundance. Reviewer 2 and the Subcommittee expected habitat capability to estimate the maximum recruitment, R_{MAX}, whence $b = a \cdot R_{max} / e^{a-1} \approx 0.73\ R_{max}$ for a near 2; this would lower all the reported S_{MSY} estimates by the same 0.73 factor.

Results

Relationships between maximum observed spawner density and gradient (habitat suitability) varied among streams. Reviewer 2 felt that mixed results suggest that gradient is not capturing all the relevant sources of environmental variation. Reviewer 1 was concerned whether the gradient-based model was generating sensible results. The Reviewer was skeptical about whether the results of a model based on a single regional index stream can be applied to all streams of that region. This Reviewer thought that it might be worth comparing the likelihood of the overall fit of the Gaussian model to the 9 streams to a 'null' model of just using the mean density as a test of the utility of gradient as an explanatory variable.

Both Reviewers felt that the paper was a good first step. Reviewer 2 thought that the paper presented an interesting exploratory analysis of existing data, whose results for certain stock groupings are sufficiently encouraging to warrant further fieldwork directed specifically at examining habitat–spawner abundance relationships.

The Subcommittee felt that is difficult to move from capacity to reference points because of two aspects of approach: 1) did the authors actually measure the Ricker parameter "b" with their estimates of spawner capability?; 2) the use of productivity estimates from other systems for the Fraser populations.

Subcommittee Conclusions

The Subcommittee felt that this Working Paper describes a developing methodology but it is premature to accept the reference points presented in the paper. The Subcommittee lauds the efforts of authors in attempting to establish habitat-based escapement goals, but the paper needs to be re-evaluated after major revision. It would be useful to do analyses in systems where a reasonable S-R relationship can be developed to compare with a habitat-based model. This would add confidence to moving with this type of analysis to locations where S-R analysis is not possible. The paper should be revised to focus on habitat-based approach and not consider S_{MSY} estimates.

Subcommittee Recommendations

The Subcommittee requested that the paper be re-presented after the authors address the problems that precede the reference point analyses; the paper should focus on habitat-based approaches and not consider S_{msy} estimates. The Subcommittee will prepare a memo outlining the revisions. The Subcommittee accepts the paper following major revision with Subcommittee review. The Subcommittee recommends not accepting the provisional reference points.

S2002-10: Status of Sakinaw Lake sockeye salmon (Oncorhynchus nerka)

C.B. Murray and C. Wood **Accepted with Revisions**

Rapporteur: Richard Bailey

The objective of this paper was to provide an update on the status of Sakinaw Lake sockeye salmon in Statistical Area 16 and to review current understanding of reasons for their decline.

Data

Data used in this report included estimates of catch, spawning escapement and biological sampling information. Commercial catch data for Sakinaw sockeye specifically are not available because the non-Fraser proportion of sockeye caught in the Johnstone Strait test fisheries is identified as an aggregate only. DNA tissue samples were collected in 2001 to determine the genetic relationship of Sakinaw sockeye to other sockeye populations.

Both reviewers felt that the data and methods to support the conclusions appear to be adequate; however, Reviewer 2 suggested that the influence of other potential contributors (eg. inter-specific interactions, Sakinaw Lake limnology) to the decline was not evaluated thoroughly.

Methods

All escapement data were standardized to minimise the effect of changes in observers over time and their unknown level of thoroughness in enumerating spawners, and because escapement estimation procedures differed between years. The exploitation rate of net fisheries on Sakinaw sockeye was estimated using two methods by: 1) assuming that the harvest rate of Johnstone and Georgia Strait fisheries on Early Stuart sockeye is similar to that experienced by Sakinaw sockeye; and 2) reconstructing the potential catch of Sakinaw sockeye in the Johnstone and Georgia Strait fisheries by using racial scale analysis data and making some assumptions about the proportion of 'non-Fraser' catch to attribute to Sakinaw. Reviewer 1 indicated that there has been a substantially lower harvest of early Stuart sockeye since 1982.

Escapement estimates appeared somewhat stable from 1955 to 1985 with a peak of 16,000 sockeye in 1975. The population has decreased rapidly in the last 12 years and the 1996-2001 average is about 80 fish. Estimated exploitation rates for Sakinaw sockeye range from 20 to 55%. It appears that the increased fishing effort in Johnstone and Georgia Straits for 1977-1997 coincided with the general decline in Sakinaw escapements. Reviewer 1 was critical of the authors' suggestion of the effect of commercial fishing in Johnstone and Georgia Straits. The Reviewer suggested that if the decline of Sakinaw Lake sockeye since 1975 is related to high fishing effort in Johnstone and Georgia Straits, then the population should be showing indications of rebuilding since at least 1994. The authors noted that, since 1994, Sakinaw sockeye escapements increased from 14 to 100. In addition, the Reviewer felt that assumptions placing Sakinaw Lake sockeye timing (presence) in the Johnstone Strait fishery in August were not well founded. The authors agreed and stated that evidence is largely circumstantial. The authors based the presence of Sakinaw sockeye in Johnstone Strait on a protracted run timing (May to September) for Sakinaw sockeye, an assumed migration time of 7 to 14 days through Johnstone Strait to Sakinaw Lake, racial scale analysis, and limited tagging information. They noted that scale analyses show that Sabine Channel fisheries do catch Sakinaw Lake sockeye. Finally, the Reviewer felt that the authors appear to have discounted the likelihood the Sakinaw Lake sockeye delayed in the Agamemnon Channel-Pender Harbour area. The authors reported that there is no evidence for Sakinaw Lake sockeye holding in Agememnon Channel.

Results

The Subcommittee discussed issues associated with error in the escapement estimates and uncertainty with respect to interception of Sakinaw Lake sockeye in commercial fisheries. What was key was that it should be recognised that this population is a risk and is caught in commercial fisheries. It was noted that some genetic information for Sakinaw sockeye does exist. The authors reported that mitochondrial DNA and allozyme analyses show that Sakinaw Lake sockeye are genetically unique.

Subcommittee Conclusions

The Subcommittee concluded that, based on existing genetic information, Sakinaw sockeye are distinct. Given the implications of Sakinaw Lake sockeye status, there is a need to clearly document all information relevant on stock differentiation and identification. There was concern that the estimate of diversion rate for Sakinaw sockeye, ultimately based on the rate for all Fraser sockeye in general, may be too high because the diversion rate for early Stuart sockeye is much lower than for other Fraser sockeye populations. The PSC may have the data to estimate diversion rate for Sakinaw sockeye. The consequences of change in estimated diversion rate would be reduced harvest rate and productivity estimates.

The Subcommittee asked the authors to re-estimate diversion and harvest rates in the revision.

Subcommittee Recommendations

The Subcommittee accepted the Working Paper with revisions. It recommends that work on a recovery plan begin as soon as possible. This includes developing a comprehensive statement on stock status, identifying risk factors and designing measures to offset those risk factors. Experts can determine the priority of parts of the recovery plan. The specific recommendations of this Working Paper should be considered in the plan. Monitoring programs should continue through the recovery plan process. Accurate smolt and adult enumeration is a high priority.

APPENDIX 1: Working Paper Summaries

S2002-07: Biological escapement goals for Yukon River fall chum salmon

D. Eggers

Available information was assembled concerning estimated escapements, harvests, and age composition of fall chum salmon *Oncorhynchus keta* returning to the Yukon River drainage in Alaska during the years 1974-1999. This information was used to reconstruct annual runs of fall chum salmon to the Tanana River, the Upper Yukon River Tributaries (Chandalar, Fishing Branch, and Sheenjek Rivers), and the Upper Yukon River mainstem (the stocks enumerated at the U.S./Canada border and spawning upstream of the border). Brood tables consisting of estimated escapements and resultant age-specific recruits for the 1974 – 1995 brood years were developed for these stocks. These data were subsequently used to estimate spawner-recruit relationships based upon the estimated escapements of salmon to the Tanana River, Upper Yukon tributaries, and the Upper Yukon River mainstem during the years 1974-1995 and recruits resulting from these escapements 3, 4, 5, and 6 years later. These spawner-recruit relationships were used to estimate the number of spawners that would, on average, provide for maximum sustained yield of this stock of chum salmon in fisheries that are believed to harvest this stock.

S2002-08: A discussion paper on proposed stock groupings for Fraser River chinook

J.R. Candy, J.R. Irvine, C.K. Parken, S.L. Lemke, R.E. Bailey, M. Wetklo and K. Jonsen

Based upon genetic, life history characteristics, and consideration of whether these groups represent an important component in the evolutionary legacy for the species, Fraser River chinook salmon populations were provisionally divided into five or possibly six potential Evolutionary Significant Units (ESUs). These ESUs could also constitute Conservation Units (CUs), defined in the (draft) Wild Salmon Policy as a group of one or more populations that share a common genetic lineage and can be managed effectively as a unit by virtue of their common productivity and vulnerability to existing fisheries. We further divided these 5 (or 6) units according to manageability considering: productivity, marine catch distributions, lower river entry timing, and potential terminal fisheries management requirements. The productivity sub-groupings were intended to reduce the likelihood of over exploitation of less productive stocks. Patterns in marine recovery were not sufficiently distinct among groups to result in additional partitioning but when freshwater and terminal fisheries management purposes were considered, additional potential sub-grouping resulted in at least 11 groups and possibly 60 separate Conservation Units. Since management targets will need to be established for each Conservation Unit, annual management and assessment costs will be higher when more units are identified. However, with more CUs there may be additional fishing opportunities, and therefore

these additional costs may be more than paid for. Before we can finalise the number and size of CUs for Fraser chinook we need to better articulate management objectives within each potential unit, and also consider the potential economic and social costs and benefits at each level.

S2002-09: Habitat-based methods to develop escapement goals for chinook salmon in the Fraser River

C. K. Parken, J.R. Irvine, R.E. Bailey and I.V. Williams

DFO requires escapement goals for chinook salmon populations to achieve the objectives established by international agreements and domestic policy. In the Fraser River watershed, a stock-recruitment approach generated an escapement goal for one population, however insufficient data exists for the remaining populations to apply this method. In this report we focus on the development of alternate habitat models to produce escapement goals for chinook salmon returning to the Fraser River watershed.

To generate escapement goals, a stepwise process was developed that initially stratified spawning systems by their biophysical characteristics. Within each stratum, spawner density biostandards and spawner density-habitat relationships were developed, and models predicted the spawner capacity of systems based on the amount of spawning habitat. These models were applied within two of eight population strata as case studies to assist with evaluating the habitat-based approach and provide provisional reference points for several populations for discussion purposes.

Spawner habitat capacity models were useful for generating escapement goals for Fraser River chinook salmon, however additional information is required before these models will generate realistic goals for chinook in high gradient and confined-channel spawning systems. Spawner-density gradient relationships were significant for several population strata and escapement goals developed from relationships with moderate coefficients of determination had wide confidence intervals. Escapement goals were sensitive to the scaling factors and goals will be overestimated when scaling factors have positive bias. Stock productivity from populations outside of our study area were used to calculate S_{MSY} and bias was not assessed, accordingly S_{MSY} estimates should be interpreted cautiously. Additional work is required to improve the confidence intervals surrounding escapement goals, to develop accurate scaling factors, and to apply representative stock productivity values to aggregates of Fraser River chinook populations.

S2002-10: Status of Sakinaw Lake sockeye salmon (Oncorhynchus nerka)

C.B. Murray and C. Wood

This report summarizes our current knowledge of Sakinaw Lake sockeye salmon (*Oncorhynchus nerka*). Sakinaw Lake is located on the Sechelt Peninsula in DFO management Area 16. Data were collected between 1939-2001. Quantity of data available for each year varied, ranging from intensive total fishway counts in some years to one-time escapement surveys in others. Catch information, smolt production estimates, and basic biological characteristics for Sakinaw sockeye are very limited. Sakinaw Lake sockeye salmon have shown recent dramatic declines in total abundance. All available data indicate that the critically low sockeye returns to Sakinaw Lake in 1999, 2000, and 2001 are a result of the compounding effect of poor marine survival and low brood year escapements. If marine survival continues to be poor and escapement levels continue to decrease for Sakinaw sockeye, drastic measures are required to prevent the downward spiral to extirpation.

Major concerns that have lead to the conclusion that if present conditions continue, Sakinaw Lake sockeye salmon are likely to become extirpated in the foreseeable future include: loss of spawning habitat in the lake, low summer water levels and high temperatures that periodically block migration into the lake, past logging effects and the present effects of residential development around the lake, and the high fishing effort in Johnstone and Georgia Straits. All these factors have contributed to the overall downward trend in abundance.

Opportunities exist for enhancement and restoration of the lakes' sockeye stock, which include increasing escapements, fry outplants, improvements to spawning grounds, and control of competitors or predators. However, a comprehensive recovery plan should be developed for Sakinaw sockeye salmon to explore all the options, to ensure that the proposed measures address the recovery of Sakinaw sockeye, address local and regional concerns, and do not contribute to further harm.

APPENDIX 2: PSARC Salmon Subcommittee Meeting Agenda MAY 13 and 14, 2002

PSARC Salmon Subcommittee Meeting
May 13 & 14, 2002
Dorchester Hotel
Nanaimo, BC

Monday, May 13 - 9:00 am

9:00	–	9:30	Introduction and procedures
9:30	–	10:00	Biological escapement goals for Yukon River fall chum salmon (Eggers)
10:00	–	10:30	Break
10:30	–	12:00	Eggers continued
12:00	–	13:00	Lunch
13:00	–	13:30	Review rapporteur report
13:30	–	15:00	Habitat-based methods to develop escapement goals for chinook salmon in the Fraser River (Parken et al.)
15:00	–	15:30	Break
15:30	–	16:00	Parken et al. continued
16:00	–	16:30	Review rapporteur report

Tuesday, May 14 - 8:30 am

8:30	–	10:00	Status of Sakinaw Lake sockeye salmon (Murray and Wood)
10:00	–	10:30	Break
10:30	–	11:00	Murray and Wood continued
11:00	–	11:30	Review rapporteur report
11:30	–	13:00	Lunch
13:00	–	15:00	A discussion paper on proposed stock groupings for Fraser River chinook (Candy et al.)
15:00	–	15:30	Break
15:30	–	16:00	Review rapporteur report
16:00			Adjournment

APPENDIX 3: List of Attendees

Subcommittee Chair: Ron Tanasichuk
PSARC Chair: Max Stocker

DFO Participants	**Mon**	**Tues**	
* denotes Subcommittee Members			
Bailey, Don*	x	x	
Bailey, Richard*	x	x	
Beacham, Terry	x		
Bradford, Mike*	x	x	
Candy, John		x	
Cass, Al*	x	x	
Cox-Rogers, Steve*	x	x	
Dobson, Diana		x	
Fast, Elmer	x		
Galbraith, Ryan		x	
Godbout, Lyse	x		
Gordon, Jen	x		
Hargreaves, Brent*	x	x	
Holtby, Blair*	x	x	
Hyatt, Kim*	x		
Ionson, Bert*	x	x	
Irvine, Jim*	x	x	
Johnston, Sandy*	x	x	
Lemke, Sue*	x	x	
McBain, Grant		x	
McNicol, Rick	x	x	
Murray, Clyde		x	
Parken, Chuck*	x	x	
Saito, Wayne*		x	
Simpson, Kent		x	
Sturhahn, Julian		x	
Tompkins, Arlene	x	x	
Yockey, Cindy	x	x	
External Participants:			**Affiliation**
Atkinson, Mary-Sue	x	x	PFRCC
Borbz, Bonnie	x		Alaska Dept. of Fish & Game
Brannian, Linda	x		Alaska Dept. of Fish & Game
Chow, Sharon	x	x	Sierra Club of BC
Eggers, Douglas	x		Alaska Dept. of Fish & Game
Kristianson, Gerry	x		SFAB

Maynard, Jeremy		x	SFAB
Johnston, Tom	x	x	BC Fisheries Branch
Riddell, Brian	x	x	PFRCC
Wilson, Ken	x	x	Fraser River Aboriginal Fisheries Secretariat
Observers:			
Connolly, Ken	x		Area E, Gillnetters Assoc.
Dunlop, Roger	x	x	Nuu-Chah-Nulth Tribal Council
Hansen, Doug			Yale First Nation
Hope, Dominic	x	x	Yale First Nation

Reviewers for the PSARC papers presented at this meeting are listed below, in alphabetical order. Their assistance is invaluable in making the PSARC process work.

Beacham, Terry	Fisheries and Oceans
Bradford, Mike	Fisheries and Oceans
Cass, Al	Fisheries and Oceans
Dobson, Diana	Fisheries and Oceans
Gillespie, Graham	Fisheries and Oceans
Johnston, Tom	BC Ministry of Fisheries
Riddell, Brian	PFRCC
Saito, Wayne	Fisheries and Oceans